MAGNESIUM COMPOUNDS

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Dead-burned magnesia production in 2003 was 31% lower than that in 2002 primarily because of the closure of one of two U.S. dead-burned magnesia producers in September. Dead-burned magnesia consumption, however, fell by only 8% as imports from China continued to supply most of the U.S. demand. For dead-burned magnesia, net imports (imports minus exports) supplied 79% of U.S. consumption. A lower demand for magnesia refractories from the steel industry contributed to the decreased domestic consumption. Caustic-calcined magnesia production increased by about 21%, and consumption was about 15% higher because of increased use of magnesia in environmental applications. Net imports of caustic-calcined magnesia supplied about 48% of domestic demand.

About 58% of U.S. magnesium compounds production came from seawater and well and lake brines. The remainder was recovered from brucite, dolomite, magnesite, and olivine. About 56% of the total consumption of magnesium compounds was for refractory applications. The remaining 44% was used in agricultural, chemical, environmental, and other applications. China remained the dominant supplier of imports for refractory and caustic-calcined magnesias with 82% and 62%, respectively, of the totals.

Production

Changes in magnesium compounds production from 2002 to 2003 were mixed (table 3). Refractory magnesia and magnesium carbonate production declined, caustic-calcined magnesia and magnesium sulfate production were higher, and magnesium hydroxide production was essentially the same.

Data for magnesium compounds were collected by the U.S. Geological Survey from one voluntary survey of U.S. operations. Of the 19 operations canvassed, 74% responded, representing 57% of the magnesium compounds shipped and used (table 3). Data for the five nonrespondents were estimated on the basis of prior-year consumption levels and other factors.

The largest magnesite production facilities in the world are in China, North Korea, and Russia. Together, these three countries account for two-thirds of the world magnesite production capacity. Japan and the United States account for about one-half of the world's magnesium compounds production capacity from seawater or brines. Fused magnesia is produced in Australia, Brazil, Canada, China, Israel, Japan, the Republic of Korea, Mexico, Russia, the United Kingdom, and the United States. World production capacity is estimated to be about 650,000 metric tons per year (t/yr), including about 500,000 t/yr of capacity in China.

Fused magnesia was produced by two companies in the United States—Newminco Inc. with a plant in Midway, TN, and UCM Group PLC of the United Kingdom, which operated a plant in Cherokee, AL, through its subsidiary Muscle Shoals Minerals Inc.

Norway is the world's principal producer and supplier of olivine. Other producers include Australia, Austria, Brazil, China, Italy, Japan, the Republic of Korea, Mexico, Spain, Taiwan, Turkey, and the United States. Rudi (2001) estimated that total world production of olivine averaged about 4 million metric tons per year (Mt/yr), with about 3.3 Mt/yr consumed in Europe. An additional 4 Mt/yr of dunite and serpentinite that is often commercially called olivine is produced.

Two companies in the United States produced olivine—Unimin Corp. and Olivine Corp. Unimin operated two mines, one in North Carolina and one in Washington, and processing plants in Indiana, North Carolina, and Washington. Olivine operated one mine and one processing plant in Washington.

At the beginning of 2003, The Dow Chemical Co. announced that it would idle its Ludington, MI, brine production facility and would purchase brine from Martin Marietta Magnesia Specialties LLC. Dow was installing a 43-kilometer (km) pipeline to feed the brine from Martin Marietta's Manistee, MI, plant to its plant. Dow has recovered calcium chloride and magnesium hydroxide from the brine pumped in Ludington for the past 60 years (Ludington Daily News, 2003a§[1]). Dow has sold magnesium hydroxide brine to ANH Refractories Co. for conversion into dead-burned magnesia at its nearby plant, but because Dow no longer produced its feed, ANH Refractories closed the plant in September. ANH Refractories employed 70 workers at the Ludington facility (Ludington Daily News, 2003b§).

In January, Premier Chemicals LLC purchased the caustic-calcined magnesia and magnesium hydroxide product line of the United Kingdom's only magnesia producer, CJC Chemicals & Magnesia Ltd. Premier Chemicals will supply CJC's customers with materials produced at its Port St. Joe, FL, plant, and CJC will continue to produce magnesium hydroxide slurry at its Hartlespool, United Kingdom, plant to supply to local customers. CJC's and Premier Chemicals' magnesia furnaces had been running at less than their design capacity, so moving production from Hartlespool to Florida would increase Premier Chemicals' capacity utilization and improve its profitability. The purchase agreement between the two firms also included a technology exchange. Premier Chemicals agreed to provide CJC with technology for producing magnesium hydroxide slurry at a magnesia content of 58%, and CJC would

[1]References that include as section mark (§) are found in the Internet References Cited section.

provide Premier Chemicals with technology for producing highly reactive catalyst grades of magnesium hydroxide slurry that can be sold into high-value niche markets (Industrial Minerals, 2003g).

Consumption

In 2003, environmental applications (water treatment and stack gas scrubbing, in descending order) were the largest tonnage end use for caustic-calcined magnesia with 45% of the total. Chemical intermediates were the second largest end use, with 28% of the total. The following categories, with the individual components in descending order of consumption in parentheses, were the other end-use sectors for caustic-calcined magnesia: agriculture (animal feed and fertilizers), 21%; construction (primarily oxychloride and oxysulfate cements), 3%; manufacturing (rubber, fuel additives, fluxes, and electrical), 2%; pharmaceuticals and nutrition (sugar and medicine and pharmaceuticals), less than 1%; and unspecified uses, less than 1%.

Magnesium carbonate was used principally as a chemical intermediate, in medicines and pharmaceuticals, in rubber processing, and in cosmetics (uses are given in descending order of quantity). Magnesium hydroxide was used mainly for water treatment and in the chemical industries. Smaller applications for magnesium hydroxide were in medicine and pharmaceuticals, in the construction industry, and in rubber processing. Magnesium sulfate was used mostly for animal feed, chemical, pulp and paper, and pharmaceutical applications. Magnesium chloride was used mainly for ice control and in medicines and pharmaceuticals. Magnesium chloride brines were used principally for road dust and ice control and as a chemical intermediate.

Foundry uses remained the largest application for olivine in the United States, accounting for 80% of consumption of domestically produced material. Slag conditioning accounted for 9% of U.S. consumption; sandblasting and other abrasive uses, 6%; and refractory applications, 5%.

Prices

Changes to yearend 2003 prices for magnesium compounds from those at yearend 2002 were mixed (table 4). Prices for magnesium chloride (hydrous), magnesium hydroxide slurry, and magnesium sulfate, quoted in Chemical Market Reporter, increased from those at yearend 2002. Dead-burned magnesia prices fell, and prices for the remaining magnesium compounds remained the same. Some of the price increases were in response to higher energy costs, and several companies announced additional price increases, which would begin in 2004, that were attributed to higher energy costs.

Foreign Trade

Exports of dead-burned and caustic-calcined magnesia from the United States both fell from the level in 2002 (table 5). Dead-burned magnesia exports dropped by 33% to 56,500 metric tons (t). Canada (67%) was the principal destination. Caustic-calcined magnesia exports totaling 4,060 t were 27% less than those in 2002. France (45%) and the Netherlands (29%) were the main destinations.

Imports of dead-burned magnesia fell by about 4% from those in 2002 (table 7). U.S. imports of dead-burned magnesia in 2003 were 379,000 t with imports from China representing 82% of the total. Australia, with 6% of the total, remained the second-largest source of dead-burned magnesia. Imports of caustic-calcined magnesia totaling 150,000 t were slightly higher than those in 2002. China (62%) and Canada (29%) were the primary sources.

Trade data for olivine are not available separately from the U.S. Census Bureau. The Journal of Commerce Port Import/Export Reporting Service (PIERS), however, provides data on material that travels by ship. U.S. exports of olivine in 2003 were 760 t, with 72% of the material shipped to Argentina. U.S. olivine imports totaled 216,000 t, a 220% increase from those in 2002. Norway was the source of almost all (99.9%) U.S. olivine imports.

World Review

Australia.—The financial collapse of Australian Magnesium Corp. Ltd.'s (AMC) Stanwell magnesium project in June did not have a significant effect on the operations of AMC's subsidiary [Queensland Magnesia Corp. (QMAG)] that produces magnesia at a 180,000-t/yr magnesia plant near Parkhurst, Queensland. QMAG, in addition to producing magnesia for sale, was supposed to supply magnesite feed to the Stanwell magnesium plant when it was completed. QMAG, however, was required to restructure its debt in order to continue to operate. QMC Finance Pty. Ltd. (a wholly owned subsidiary of AMC) restructured some of its foreign currency hedge contracts associated with the QMAG business. Through this process, A$5 million was generated and was used to supplement existing funds to meet QMAG's short-term obligations. AMC has stated that this debt position is not sustainable for the long term and the future feasibility of the QMAG business is dependent on restructuring the debt facility. Although the company continued to discuss ways to restructure the debt, the debt continued to be guaranteed by Newmont Mining Corp., one of the partners in the Stanwell magnesium project (Australian Magnesium Corp. Ltd., 2003§, 2004§). Even with its financial uncertainty, QMAG continued to develop additional products. During the fourth quarter, QMAG signed a memorandum of understanding with Cement Australia Ltd. to toll produce up to 25,000 t/yr of caustic-calcined magnesia in Cement Australia's nearby Rockhampton, Queensland, cement-lime kiln during 2004 and 2005. Production was scheduled to begin about mid-2004. The toll production will burn low-grade magnesite for use in agricultural markets in New Zealand and Southeast Asia. QMAG also planned to install a briquetting plant at

Parkhurst during the first quarter of 2004 to process up to 20,000 t/yr of various magnesia waste streams for use in the steel industries in Australia, New Zealand, and Southeast Asia (Australian Magnesium Corp. Ltd., 2004§).

Mineral Holdings Australia Pty. Ltd., based in Toorak, Victoria, was seeking a joint-venture partner to take an 80% interest in six magnesite-dolomite deposits in Tasmania. Two of the deposits, the Arthur River and Lyons River deposits, are owned by Tasmania Magnesite NL [a subsidiary of Indcor Corp. (formerly Crest Magnesium NL)]. Indcor originally planned to use the magnesite in these deposits as raw material for a primary magnesium plant, but after the financial difficulties faced by AMC, Indcor decided to abandon the magnesium business and concentrate on ethanol. Resources at the six deposits in the Togari and Carbonate Hills area were estimated to be 1,000 million metric tons (Mt) of dolomite, dolomitic limestone, limestone, and magnesite. If a partner is found, the company plans to produce dolomite and dolomitic limestone for use as flux in basic oxygen steel plants and alumina refineries and magnesite for refractory applications (Industrial Minerals, 2003c; Indcor Ltd., 2004§).

China.—In February, a new Chinese magnesia export association was formed that controlled about 70% of the country's magnesite export licenses in 2003. This new association represents the fourth time that China's major magnesite producers have attempted to form an association that would stabilize the country's magnesite supply by setting floor prices and controlling quality and volumes of material exported. The new export association set floor prices for magnesia from $105 to $160 per metric ton for 2003, depending on quality. These prices were about $10 to $15 per ton higher than those at the end of 2002, reflecting increased energy costs in China. The magnesite export license fee for 2003 was $54.30 per ton, the same as the fee in 2002 (Industrial Minerals, 2003e).

Greece.—In June, Grecian Magnesite S.A. signed an agreement with United Kingdom-based UCM to transfer part of UCM's fused magnesia production from Hull, United Kingdom, to Grecian Magnesite's Chalkidiki, Greece, plant. Grecian Magnesite had supplied special qualities of caustic-calcined and dead-burned magnesia to UCM's plants in the United Kingdom and the United States. The products, which will be produced in a new 8,000-t/yr facility in Greece, are used in low-temperature heating elements found in household appliances. The new plant was completed by the end of 2003 (Industrial Minerals, 2003a).

Greenland.—United Kingdom-based Crew Development Ltd. signed an agreement with Sweden's Minelco AB to complete a bankable feasibility study for the Seqi olivine project, which is 90 km north of Nuuk on the southwestern coast of Greenland. As part of the agreement, Minelco has an option to acquire 51% of the Seqi project and be responsible for all capital costs for the development of a mining operation if the feasibility study warrants development; Crew would be responsible for drilling costs and the cost of the study. The study was expected to be completed by the first half of 2004. By December, Crew had drilled 22 holes to a depth of 100 meters each. Geological mapping done by the company outlined the surface size of the deposit, which indicates a potential resource of 1 Mt per vertical meter. Assaying of more than 5 t of material from 998 samples was being completed, which would form the basis for a full resource evaluation (Taylor, 2003).

Italy.—In July, Cogema SpA's 85,000-t/yr magnesia plant ceased production. Although no definitive reason was given for the closure, technical problems with a vertical shaft kiln installed in 2002, product contamination from ash fallout from the eruption of Mt. Etna in December 2002, and high energy costs were cited as potential contributing factors. No determination has been made about whether the plant will reopen (O'Driscoll, 2003).

Jordan.—Jordan Magnesia Co. experienced delays in the planned startup of its new 60,000-t/yr magnesia plant at Al-Safi. The plant, which will recover magnesia from the Dead Sea, was scheduled to begin production by yearend 2002. By the end of 2003, the caustic-calcined magnesia plant was commissioned, and the multiple-hearth furnace that will be used to produce dead-burned magnesia was undergoing final trial runs. The plant is expected to have products available for evaluation at the beginning of 2004. Possehl S.A., based in Athens, Greece, is the market consultant and sales agent for Jordan Magnesia's products (O'Driscoll, 2003).

Korea, North.—The principal magnesite deposits are located in Hamgyŏng-namdo and average on a crude basis 45% magnesium oxide (MgO). The production of crude magnesite has been reported to be in excess of 1 Mt/yr. Korea Magnesia Clinker Industry Group operates three mines and plants in Hamgyŏng-namdo that employ about 30,000 people and produce primarily dead-burned magnesia, although small quantities of caustic-calcined magnesia and fused magnesia also are produced. The open pit mine has a capacity of 1.3 Mt/yr, and the two underground mines have a combined capacity of 1.2 Mt/yr. The combined capacity of the three plants is estimated to be 1.15 Mt/yr. The company produces four grades of dead-burned magnesia—the Grade A product contains a minimum of 90% MgO and maximums of 4.5% silicon dioxide and 2% calcium oxide. A small portion of North Korea's magnesia production is exported to Japan, Taiwan, other Southeast Asian countries, and Europe, but the majority is used by the country's steel industry (Industrial Minerals, 2003f).

Netherlands.—Nedmag Industries Mining and Manufacturing BV installed new electrostatic precipitators at its Veendam brine plant to minimize dust emissions. The company also planned to debottleneck and upgrade the plant to increase production to its design capacity of 160,000 t/yr by 2006 (Industrial Minerals, 2003d).

Norway.—In June, North Cape Minerals AS purchased the Norwegian Government's 51% ownership of olivine producer A/S Olivin for $45.5 million. This purchase makes North Cape Minerals the sole owner of the company, following its purchase of 49% of Olivin in 2001. Olivin is the world's leading supplier of olivine, with sales of about 4.3 Mt/yr. North Cape Minerals [owned by U.S.-based Unimin Corp. (84%) and Norway's Franzfoss Bruk A/S (14%)] also produced olivine from a separate mine in Norway, although production from this mine is estimated to be much smaller—about 0.5 Mt/yr (Taylor, 2003).

Russia.—JSC Kombinat Magnezit planned to increase its existing capacity to produce fused magnesia. By 2005, the company expected to increase production capacity to 33,000 t/yr from its current level of 24,000 t/yr. The company also planned to develop a magnesium deposit in the Krasnoyarsk region to increase the volume and quality of magnesia production. JSC Kombinat Magnezit is the largest producer of magnesia in Russia with a capacity of 2.4 Mt/yr of dead-burned magnesia and 100,000 t/yr of caustic-calcined magnesia in addition to its fused magnesia production (Industrial Minerals, 2003b).

Outlook

Worldwide refractory magnesia consumption is influenced by several trends—consolidation within the refractories industry, decreasing consumption because of technologic development in the steelmaking industry, production of higher quality refractory materials leading to longer furnace lining lives, a shift from basic oxygen furnaces to electric arc furnaces in steelmaking leading to increased use of basic (magnesia-based) refractories, and a greater demand for high-purity dead-burned magnesia with a bulk density greater than 3.40 grams per cubic centimeter and crystal size greater than 120 micrometers. China has become the dominant world supplier of dead-burned magnesia in the low- to medium-grade markets. As a result, many producers of these grades have closed because they could not compete with the lower priced Chinese material.

In the United States, the dead-burned magnesia market is likely to continue to be dominated by imports. Within the past 5 years, the United States has lost three producers of dead-burned magnesia and is left with only one. In addition, the steel production industry has contracted, leaving fewer markets for dead-burned magnesia. In 2003, U.S. steel production was estimated to be slightly lower than that in 2002. Some U.S. steel companies continued to have financial difficulties and filed for bankruptcy protection in 2003. The section 201 tariffs on a wide range of steel products that were instituted in 2002 were determined to be illegal in a final ruling by the World Trade Organization in November 2003. In December, the U.S. tariffs were lifted by the President. In China, however, steel production in 2003 increased by more than 20% from that in 2002, and it became the first country to produce more than 200 Mt of steel in 1 year. The significant increase in Chinese production coupled with a potential downturn in U.S. steel production would limit the need for dead-burned magnesia in the United States. Imports, primarily from China, will continue to be a significant source of dead-burned magnesia supply for the United States; however, increased Chinese steel production could increase demand for dead-burned magnesia from China's steel industry, limiting the quantity available for export to the United States.

Future demand for caustic-calcined magnesia appears to be a little brighter. Use of magnesia and magnesium hydroxide in water treatment is growing, reflecting increased environmental concerns and increased acceptance of magnesium hydroxide as a substitute for caustic soda. Caustic-calcined magnesia use in animal feed markets is steady, but imports of caustic-calcined magnesia from China are increasingly being barged up the Mississippi River to the major farming States for use in agriculture. This increase in imported material is likely to continue mainly because of its lower cost compared with U.S.-produced magnesia. Most markets for caustic-calcined magnesia are mature, with the exception of water-treatment applications. Because caustic-calcined magnesia has diverse applications, a decline in one particular industry sector is not as devastating as a drop in steel production is to the refractory magnesia industry.

With the exit of Dow from the magnesium hydroxide market, magnesium hydroxide supplies in the United States have become tighter. In addition, prices on U.S.-produced magnesium hydroxide have increased, reflecting increased energy costs. Reduced supplies and increased costs have opened some of magnesium hydroxide's markets to competing materials. In environmental applications, such as water treatment, magnesium hydroxide competes with caustic soda. Caustic soda prices have declined, and although magnesium hydroxide has a higher neutralization capacity per kilogram than caustic soda, an increasing price differential could cause some users to switch to caustic soda (Van Savage, 2004).

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TABLE 1
SALIENT MAGNESIUM COMPOUND STATISTICS[1]

(Thousand metric tons and thousand dollars)

	1999	2000	2001	2002	2003
United States:					
Caustic-calcined and specified magnesias:[2]					
Shipped by producers:[3]					
Quantity	179	172	136	127	154
Value	77,000	46,000	43,300	38,100	61,000
Exports[4]	3	12	4	6	4
Imports for consumption[4]	123	136	130	148	150
Refractory magnesia:					
Shipped by producers:[3]					
Quantity	216	196	213	123	84
Value	75,300	68,100	71,300	37,800	23,500
Exports	67	60	63	73	56
Imports for consumption	392	501	363	394	379
World, production of magnesite	9,830	12,700	11,100 r	12,700 r	11,900 e

eEstimated. rRevised.
[1]Data are rounded to no more than three significant digits.
[2]Excludes caustic-calcined magnesia used in the production of refractory magnesia.
[3]Includes magnesia used by producers.
[4]Caustic-calcined magnesia only.

TABLE 2
U.S. MAGNESIUM COMPOUND PRODUCERS, BY RAW MATERIAL SOURCE, LOCATION, AND PRODUCTION CAPACITY, IN 2003

Raw material source and producing company	Location	Capacity (metric tons of MgO equivalent)[1]	Products
Brucite, Applied Chemical Magnesias Corp.	Van Horn, TX, and Bullhead City, AZ	25,000	Magnesium hydroxide.
Magnesite, Premier Chemicals LLC	Gabbs, NV	140,000	Caustic-calcined magnesia.
Lake brines:			
Great Salt Lake Minerals Corp.	Ogden, UT	106,000	Magnesium chloride and magnesium chloride brines.
Reilly Industries Inc.	Wendover, UT	45,000	Magnesium chloride brines.
Well brines:			
The Dow Chemical Co.[2]	Ludington, MI	214,000	Magnesium hydroxide.
Martin Marietta Magnesia Specialties LLC[3]	Manistee, MI	297,000	Caustic-calcined and dead-burned magnesia.
Rohm and Haas Co.	do.	25,000	Magnesium carbonate, magnesium hydroxide, and caustic-calcined magnesia.
Seawater:			
Premier Chemicals LLC	Port St. Joe, FL	75,000	Caustic-calcined magnesia and magnesium hydroxide.
SPI Pharma Inc.	Lewes, DE	5,000	Magnesium hydroxide.
Western Salt Co.	Chula Vista, CA	3,000	Magnesium chloride brines.
Total		935,000	

[1]Data are rounded to no more than three significant digits; may not add to total shown.

[2]Most of Dow's production was shipped to ANH Refractories Co. in Ludington, MI, where it was converted to dead-burned magnesia at a 200,000-metric-ton-per-year-capacity plant. Dow stopped producing magnesium hydroxide, and ANH's plant was closed in September 2003.

[3]In addition to its Michigan plant, Martin Marietta owned a 15,000-metric-ton-per-year-capacity magnesium hydroxide plant in Lenoir City, TN, which used imported magnesite as a raw material.

TABLE 3
U.S. MAGNESIUM COMPOUNDS SHIPPED AND USED[1]

	2002		2003	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Caustic-calcined and specified (USP and technical) magnesias[2]	127,000	$38,100	154,000	$61,000
Magnesium hydroxide [100% $Mg(OH)_2$][1]	218,000	86,900	217,000	101,000
Magnesium sulfate, anhydrous and hydrous	38,000	12,400	40,000	14,400
Precipitated magnesium carbonate[2]	1,710	4,130	1,470	3,500
Refractory magnesia	123,000	37,800	84,400	23,500

[1]Data are rounded to no more than three significant digits.
[2]Excludes material produced as an intermediate step in the manufacture of other magnesium compounds.

TABLE 4
YEAREND MAGNESIUM COMPOUND PRICES

Material		2002	2003
Magnesia, dead-burned	per short ton	$388	$363-368
Magnesia, synthetic, technical, 98% MgO	do.	488	488
Magnesium chloride, hydrous, 99%, flake	do.	290	320
Magnesium chloride, anhydrous, 92%, flake or pebble	per pound	0.145	0.145
Magnesium hydroxide, powder, technical	do.	0.45	0.45
Magnesium hydroxide slurry, technical, 100% $Mg(OH)_2$	do.	210	235-240
Magnesium sulfate, technical (epsom salts)	do.	0.175-0.21	0.18-0.215
Olivine, aggregate, free on board plant or mine	per metric ton	50-78	50-78
Olivine, foundry grade, free on board plant or mine	do.	62-109	62-109

Sources: Chemical Market Reporter and Industrial Minerals.

TABLE 5
U.S. EXPORTS OF CRUDE AND PROCESSED MAGNESITE, BY COUNTRY[1]

Material and country	2002 Quantity (metric tons)	2002 Value (thousands)	2003 Quantity (metric tons)	2003 Value (thousands)
Caustic-calcined magnesia:				
Brazil	390	$419	19	$11
France	2,850	1,660	1,850	1,060
Germany	327	193	308	177
Italy	763	406	183	93
Netherlands	856	492	1,180	678
Other	347	223	525	313
Total	5,540	3,390	4,060	2,330
Dead-burned and fused magnesia:				
Austria	6,000	1,460	--	--
Brazil	307	252	1,010	1,320
Canada	54,400	15,800	48,900	15,200
Chile	2,060	640	31	16
Germany	4,410	1,200	314	202
Korea, Republic of	1,040	513	575	389
Mexico	1,240	648	622	366
Netherlands	749	470	1,120	759
Other	2,480 r	1,980 r	3,940	2,670
Total	72,700	22,900	56,500	20,900
Other magnesia:				
Canada	6,880	2,510	7,060	2,480
Colombia	4,240	972	1,530	530
Germany	304	518	348	360
Hong Kong	866	1,050	656	800
Indonesia	1,180	659	1,200	665
Japan	5,750	4,980	5,310	4,320
Mexico	7,100	5,240	3,670	3,220
Taiwan	1,020	640	3,480	1,830
Venezuela	--	--	996	349
Other	4,520	5,480	3,280	4,300
Total	31,900	22,000	27,500	18,800
Crude magnesite:				
Argentina	762	81	1,320	141
Canada	2,260	335	1,300	181
France	2,820	302	1,810	193
Mexico	380	41	1,020	109
United Kingdom	2,250	240	4,340	481
Venezuela	8,760	1,080	6,140	701
Other	1,910 r	223 r	2,020	228
Total	19,100	2,310	18,000	2,030

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 6
U.S. EXPORTS OF MAGNESIUM COMPOUNDS[1]

Material	2002 Quantity (metric tons)	2002 Value (thousands)	2003 Quantity (metric tons)	2003 Value (thousands)	Principal destinations, 2003
Magnesium chloride, anhydrous and other	4,580	$2,340	8,150	$4,020	Canada, 93%.
Magnesium hydroxide and peroxide	14,500	11,000	13,700	8,850	Canada, 63%; Germany, 11%.
Magnesium sulfate, natural kieserite and epsom salts	3,350	449	2,460	1,060	Canada, 75%; Panama, 24%.
Magnesium sulfate, other	7,450	3,610	6,970	3,080	Canada, 87%.

[1]Data are rounded to no more than three significant digits.

Source: U.S. Census Bureau.

TABLE 7

U.S. IMPORTS FOR CONSUMPTION OF CRUDE AND PROCESSED MAGNESITE, BY COUNTRY[1]

Material and country	2002 Quantity (metric tons)	2002 Value (thousands)	2003 Quantity (metric tons)	2003 Value (thousands)
Caustic-calcined magnesia:				
Canada	49,200	$8,850	44,100	$7,550
China	88,700	9,920	92,700	9,550
Greece	4,240	1,090	11,000	2,870
Other	5,400	4,530	2,230	2,610
Total	148,000	24,400	150,000	22,600
Dead-burned and fused magnesia:				
Australia	55,700	11,400	23,000	5,440
Austria	13,100	5,380	15,600	7,630
China	286,000	40,500	310,000	49,800
Greece	4,630	1,790	5,210	1,110
Hong Kong	17,800	2,060	6,160	1,330
Israel	6,830	5,230	2,500	5,540
Mexico	1,500	456	6,090	1,950
Other	8,380 r	3,240 r	10,700	5,730
Total	394,000	70,100	379,000	78,500
Other magnesia:				
Canada	1,390	369	1,690	346
China	3,320	1,320	9,660	1,970
Israel	1,910	4,830	680	1,110
Japan	1,810	3,280	2,010	3,210
Mexico	5,830	1,870	1,490	898
Slovakia	2,770	1,180	4,620	1,670
Other	570	757	890	1,090
Total	17,600	13,600	21,000	10,300
Crude magnesite:				
Canada	20	5	2,460	169
China	5,600	428	7,590	566
Israel	709	150	97	39
Japan	3,780	813	2,370	531
Korea, Republic of	100	19	954	270
Other	1,380 r	322 r	859	168
Total	11,600	1,740	14,300	1,740

rRevised.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF MAGNESIUM COMPOUNDS[1]

	2002		2003		
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Principal sources, 2003
Magnesium chloride, anhydrous and other	20,100	$4,930	60,400	$13,200	Israel, 81%; Netherlands, 15%.
Magnesium hydroxide and peroxide	3,930	6,000	5,220	8,510	Netherlands, 41%; Austria, 23%.
Magnesium sulfate, natural epsom salts	65	29	555	153	China, 100%.
Magnesium sulfate, natural kieserite	13,300	815	13,100	653	Germany, 100%.
Magnesium sulfate, other	30,900	5,830	32,800	13,200	Germany, 36%; Canada, 26%; China, 19%.

[1]Data are rounded to no more than three significant digits.

Source: U.S. Census Bureau.

TABLE 9
WORLD MAGNESIUM COMPOUNDS ANNUAL PRODUCTION CAPACITY, DECEMBER 31, 2003[1, 2]

(Thousand metric tons of MgO equivalent)

	Raw material				
	Magnesite		Seawater or brines		
Country	Caustic-calcined	Dead-burned	Caustic-calcined	Dead-burned	Total
North America:					
Canada	150	--	--	--	150
Mexico	--	--	15	95	110
United States	140	--	300	195	635
Total	290	--	315	290	895
South America, Brazil	80	291	--	--	371
Europe:					
Austria	25	250	--	--	275
France	--	--	30	--	30
Greece	120	100	--	--	220
Ireland	--	--	--	90	90
Italy	25	--	5 [3]	70 [3]	100
Netherlands	--	--	8	150	158
Poland	--	10	--	--	10
Russia	100	2,670	--	--	2,770
Serbia and Montenegro	40	160	--	--	200
Slovakia	--	465	--	--	465
Spain	180	70	--	--	250
Turkey	20	389	--	--	409
Ukraine	--	120	20	80	220
United Kingdom	--	--	70	--	70
Total	510	4,240	133	390	5,270
Africa:					
South Africa	12	--	--	--	12
Zimbabwe	20	--	--	--	20
Total	32	--	--	--	32
Asia:					
China	200	2,500	--	10	2,710
India	28	267	--	--	295
Iran	--	30	--	--	30
Israel	--	--	10	60	70
Japan	--	--	50	250	300
Korea, North	--	1,150	--	--	1,150
Korea, Republic of	--	--	--	40	40
Total	228	3,940	60	360	4,590
Oceania, Australia	48	150	--	--	198
Grand total	1,190	8,620	508	1,040	11,400

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes capacity at operating plants, as well as at plants on standby basis.

[3]Plant closed in 2003.

TABLE 10
MAGNESITE: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

Country	1999	2000	2001	2002	2003[e]
Australia	280,505	349,783	605,314	484,498	472,668 [3]
Austria, crude	749,000	726,000	700,000 [e]	700,000 [e]	700,000
Brazil, beneficiated[4]	259,834	279,876	265,749	269,222 [r]	269,000
Canada[e, 5]	180,000	180,000	180,000	180,000	180,000
China[e]	2,450,000	4,070,000	3,580,000	3,700,000	3,700,000
Colombia[e]	10,500	10,500	10,500	10,500	10,500
Greece, crude[e]	495,144 [3]	500,000	500,000	500,000	500,000
India	360,080	365,080	370,000 [e]	380,000 [e]	380,000
Iran[6]	141,081	141,000 [e]	133,778 [r]	129,565 [r]	130,000
Korea, North[e]	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Mexico	308	335	250 [r]	-- [r]	--
Pakistan	2,175	4,192	4,200 [e]	4,000 [e]	4,200
Poland, concentrate	38,800	26,100	22,200	22,100 [r, e]	25,000
Russia[e]	900,000	1,000,000	1,000,000	1,000,000	1,200,000
Serbia and Montenegro, crude	31,000	41,000	36,000	33,000 [r, e]	35,000
Slovakia, concentrate	918,000	1,000,000	961,000 [r]	930,000 [r, e]	950,000
South Africa	73,900	63,000	36,500 [r]	87,000 [r]	85,000
Spain, calcined	211,000	266,000	260,000 [e]	250,000 [e]	250,000
Turkey, run-of-mine	1,724,744	2,672,089	1,450,031 [r]	3,044,440 [r]	2,000,000
United States	W	W	W	W	W
Zimbabwe	5,356	4,029	2,439	2,366	2,000
Total	9,830,000	12,700,000	11,100,000 [r]	12,700,000 [r]	11,900,000

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." -- Zero.

[1]World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Figures represent crude salable magnesite. In addition to the countries listed, Bulgaria produced magnesite, but output is not reported quantitatively, and available information is inadequate for formulation of reliable estimates of output levels. Table includes data available through May 20, 2004.

[3]Reported figure.

[4]Series reflect output of marketable concentrates. Production of crude ore, in metric tons, was as follows: 1999--868,604; 2000--1,006,654; 2001--1,079,207; 2002--1,087,786 (revised); and 2003--1,080,000 (estimated).

[5]Magnesitic dolomite and brucite. Figures are estimated on the basis of reported tonnage dollar value.

[6]Year beginning March 21 of that stated.